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(54) LIGHTWEIGHT METAL PISTON WITH CIRCULATING FLUID COOLING

(71) We, SOCIETE A.M.O., a Corporation organised under the laws of France, of 16 Rue Buffon Colombes (Hauts-de-Seine), France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a new forged light alloy piston with circulating fluid cooling, principally for internal combustion engines, particularly diesel engines, more especially those of the direct injection type. At the high temperatures reached by piston of this kind in the engines, particularly at high engine speeds, the fragility of the pistons becomes very great, thereby entailing numerous disadvantages in respect of operation, including the seizing of piston rings, and in respect of working life.

In order to avoid, or at least to alleviate, these disadvantages, which make it impossible to profit fully from the advantages of light piston, is has already been proposed to provide in the top portion of the piston, usually between the combustion chamber and the piston ring zone of the pistons in question, an annular chamber in which a cooling liquid circulates. Chambering of this kind was usually effected by means of channels machined on the outer crown or head of the piston or in its side surface; better results have been achieved in this way with forged pistons of light alloys, but it has not been possible to make very light pistons for lack of space to receive the chamber. Finally, it has also been proposed to make the pistons of a plurality of elements, but this has not been entirely successful.

In view of the industrial interest of light engines and the obvious advantages of forged pistons of light alloys, the invention proposes to supply a new light piston which is composed of two elements, one of which acts as flame arrester chamber, and which avoids the disadvantages mentioned above.

A forged light alloy piston provided with a chamber disposed in a cooling fluid circuit is characterized in that it comprises a forged light metal body provided with a skirt and grooves for piston rings, the top of the body forming at least a part of the combustion chamber, and a cap of metal having the same expansion as that of the light metal, this cap being secured to the top of the body, having a diameter corresponding to the outside diameter of the latter and having in its interior at least two annular grooves parallel to the piston ring grooves, the groove situated nearer or nearest to the top defining with the body a closed chamber and the other or least one of the other grooves defining with the body a chamber of chambers connected by passage means to the cooling circuit. The cap is preferably secured to the top of the body and to the periphery of the body at at least two points.

The metal of the cap may be ferrous or non-ferrous. The height of the cap is so selected as to enable it to carry on the outside the fire ring and on the inside two grooves, one of the latter containing a fluid which is inert in relation to the metals of the body and the cap while the other is connected to the cooling circuit. The inert fluid may be air or other gas or a free-flowing salt.

The cap may be fastened to the skirt by hot screwing or shrinking-on. The upper two grooves are separated by a rib so disposed that on assembly it penetrates into an annular groove formed in the outer cylindrical wall of the body.

Ducts are formed in known manner in the body to constitute respectively the inlet and outlet for cooling fluid into or from the grooves remote from the top of the cap.

Finally, particularly for pistons of rellatively large dimensions, the light metal portion of the piston according to the in-

vention may be provided in known manner, for example in the manner known from U.K. Patent No. 1,031,628 with at least one conical annular chamber for additional circulation of cooling fluid.

The "mixed" type pistons according to the invention offer the advantage that, without their cost of manufacture being excessive, they possess all the properties expected of light alloy piston, both as regards their weight and with regard to their life, which is much longer than that of corresponding light pistons made entirely of light metal or alloy.

A preferred example of construction of a forged piston according to the invention is described below with reference to the accompanying drawings, which shows a view in vertical axial section thereof.

As can be seen in the drawing, a piston 1 mounted on a connecting rod 2 shown in dot-dash lines comprises a body 3' of light metal provided with a skirt 3 and grooves 4 for the piston rings (not shown) and with the combustion chamber 5. The body 3' is machined cylindrically on its periphery over a height slightly greater than the depth of the combustion chamber 5. The top end face 6 of the body is provided with a groove 7 coaxial to the piston 1. The cylindrical wall 8 of the cut-out portion of the body 3' is threaded at 9 and ends on the outside in a step 10—11.

The cap 12, which is of ferrous metal having the same extension as the light metal or alloy of the body 3', is provided in its top perpendicular to the axis of the piston 1 with an annular rib 13 engaged in the groove 7, and also with an opening 13' in communication with the open portion of the combustion chamber 5. In its vertical portion there are provided a trapezoidal annular groove 14 and a square annular groove 15, these grooves being separated by the trapezoidal rib 16 the tip of which corresponds to the diameter of the groove 14. The bottom end 12_1 of the cap 12 is provided with a groove 4' for the fire piston ring.

In the guide portion 3' of the body there are formed two ducts 17 and 18, of which one (17) has its outlet facing the groove 15 and supplies cooling oil from the connection 19, while the other (18) has its mouth in the groove 15 on the opposite side to the duct (17) and returns the oil to the sump.

In the example illustrated there is provided for the circulation of the cooling fluid, in addition to the groove 15, a hollow crown 15' formed in the top of the body from ducts 15'' drilled from the outside at the level of the groove 15. This arrangement improves cooling still more.

This piston therefore permits cooling by fluid through the duct 17, the groove 15, and the duct 18, and is provided with a flame arrester chamber containing air and bounded by the groove 14 and the wall of the body.

WHAT WE CLAIM IS:—

1. A piston provided with a chamber disposed in a cooling fluid circuit, characterised in that it comprises a forged light metal body provided with a skirt and grooves for piston rings, the top of the body forming at least a part of the combustion chamber, and a cap of metal having the same expansion as that of the light metal, this cap being secured to the top of the body, having a diameter corresponding to the outside diameter of the latter and having in its interior at least two annular grooves parallel to the piston ring grooves, the groove situated nearer or nearest to the top defining with the body a closed chamber and the other or at least one of the other grooves defining with the body a chamber or chambers connected by passage means to the cooling circuit.

2. A piston according to claim 1 in which the cap is secured to the top of the body and to the periphery of the body at at least two points.

3. A piston according to claim 1 or claim 2 in which the said closed chamber contains a fluid which is inert in relation to the metals of the body and cap.

4. A piston according to any one of claims 1—3 in which the height of the cap is such that the cap can receive on the outside the fire piston ring and on the inside the grooves, of which one contains fluid and the other or at least one of the others is connected to the cooling circuit.

5. A piston according to any of claims 1—4 in which the cap is fixed by hot screwing to the skirt.

6. A piston according to any of claims 1—5 in which at least the upper two grooves are separated by a rib which engages an annular groove in the outer cylindrical wall of the body.

7. A piston according to any of claims 1—6 in which the closed chamber extends over the top of the body.

8. A piston according to any of claims 1—7 in which the body is provided with ducts forming respectively the inlet and outlet of the cooling fluid into and from the said other groove or grooves.

9. A piston according to any of claims 1—8 characterised in that the light metal portion has at least one conical annular chamber for additional circulation of cooling fluid.

10. A lightweight metal piston sub-

stantially as described with reference to the accompanying drawings.

11. An internal combustion engine having a piston or pistons as claimed in any one or more of claims 1—9.

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1343377 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*